

Fostering public awareness and wetland conservation through biodiversity education at Paya Indah Wetlands, Malaysia

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ABSTRACT

Paya Indah Wetlands (PIW) in Dengkil, Selangor, managed by PERHILITAN, is a biodiversity-rich reserve that serves as a sanctuary for wildlife, including the endangered saltwater crocodile (*Crocodylus porosus*) and the river hippopotamus (*Hippopotamus amphibius*), while promoting conservation, education, and ecotourism. This study evaluated the effectiveness of Communication, Education, and Public Awareness (CEPA) activities in enhancing visitor awareness of wetland and wildlife conservation. Using a mixed-method approach, data were collected from 18 January to 24 April 2025 through questionnaires, interviews, focus group discussions, and field observations involving 261 visitors aged 18 and above. Results indicate that visitors highly valued PIW's conservation and educational roles, with average ratings ranging from 4.52 to 4.58. They appreciated the site's biodiversity (M = 4.45), strongly supported ecosystem protection (M = 4.53), and felt safe during their visit (M = 4.49). These findings suggest that CEPA efforts at PIW effectively enhance public perception and environmental awareness, offering a strong baseline for targeted improvements in future education and outreach initiatives.

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1. INTRODUCTION

Wetlands are among the most productive ecosystems on Earth, offering vital ecological functions such as water purification, flood mitigation, carbon storage, and habitat provision for diverse species. Amid the escalating global biodiversity crisis, wetlands play a crucial role in sustaining ecological balance and protecting endangered flora and fauna. In Malaysia, Paya Indah Wetlands (PIW), located in Dengkil, Selangor, represents a significant national asset for wetland conservation and environmental education. Spanning an area of 450.76 hectares, PIW was officially gazetted as a protected area under Section 62 of the National Land Code on 17 February 1998. Its strategic location—near major urban centres such as Putrajaya and Cyberjaya—makes it an accessible and ideal site for biodiversity education, research, and ecotourism. PIW is home to a wide array of unique flora and fauna, including threatened species such as the estuarine crocodile (*Crocodylus porosus*), hippopotamus (*Hippopotamus amphibius*), freshwater turtles, and various wetland bird species. The ecological richness of this site underscores its importance in the national conservation agenda. Managed by the Department of

Wildlife and National Parks (PERHILITAN), PIW serves dual purposes: as a protected natural habitat and as a nature-based learning centre. It supports environmental education programmes targeted at diverse audiences, including students, researchers, policymakers, non-governmental organisations, and local communities.

The mosaic of ecosystems at PIW, including lakes, swamps, and secondary forests, provides an immersive outdoor classroom that facilitates experiential learning on ecological processes, conservation practices, and sustainability values. In the broader global context, biodiversity decline has emerged as one of the most pressing environmental concerns. Drivers such as habitat loss, illegal logging, pollution, and climate change have been widely recognised as major threats to biological diversity (Convention on Biological Diversity, 2010). In response, there is a growing consensus that effective conservation must be underpinned by comprehensive public engagement, education, and advocacy. The active involvement of communities and stakeholders in environmental management is crucial to supporting government efforts to mitigate the negative impacts of development. One strategic

approach that has gained international recognition is CEPA—Communication, Education, and Public Awareness. Promoted under global environmental frameworks such as the Convention on Biological Diversity (CBD) and the International Union for Conservation of Nature (IUCN), CEPA emphasises the need for clear communication, deep public awareness, and active participation in conservation action. Effective CEPA programmes help bridge the gap between scientific knowledge and public perception through interactive tools such as talks, workshops, exhibitions, guided field visits, and experiential learning materials. Paya Indah Wetlands (PIW), Selangor, offers an ideal setting for CEPA activities—particularly environmental education—due to its unique combination of natural and artificial habitats housing diverse flora and fauna, and its well-appointed facilities capable of hosting both daily and overnight educational programs. This article aims to identify the effectiveness of CEPA (Communication, Education, and Public Awareness) activities implemented at the Wildlife Conservation Centre of Paya Indah Wetlands in enhancing visitors' knowledge, awareness, and commitment towards wildlife conservation efforts. Through this research, proposed programme enhancements were also developed to strengthen the implementation of CEPA initiatives at PIW and similar protected areas, reinforcing their role as inclusive and transformative platforms for conservation education.

1.1. Literature review: Wetlands and their ecological significance

Wetlands are among the most productive ecosystems on Earth, offering crucial ecosystem services such as flood control, water purification, carbon sequestration, and habitats for diverse species (Ramsar Convention Secretariat, 2016). In Malaysia, wetlands like Paya Indah Wetlands (PIW) represent vital biodiversity hotspots, supporting various flora and fauna, including endangered species such as the Malayan false gharial (*Tomistoma schlegelii*) and waterbirds (Wetlands International Malaysia, 2020). Despite their ecological value, wetlands face increasing threats due to urban development, pollution, and habitat fragmentation (MMD, 2021). Raising public awareness is essential to conservation, especially in wetlands, which often lack visibility compared to forests or marine systems.

Studies have shown that public understanding of wetlands is generally low, particularly concerning their ecological functions and the threats they face (UNESCO, 2019). Education and awareness campaigns have been identified as effective tools in bridging this gap (Gough, 2002; Sterling et al., 2017). The CEPA framework—Communication, Education, and Public Awareness—was developed under the Ramsar Convention to serve as a strategic tool for engaging the public in wetland conservation (Ramsar Convention, 2008). CEPA emphasizes participatory approaches, stakeholder

engagement, and capacity building to foster behavioural change. In practice, CEPA programs range from interpretive signage and guided tours to interactive exhibitions, school outreach, and community engagement efforts.

Malaysia has incorporated CEPA into its conservation strategies, especially within protected areas managed by the Department of Wildlife and National Parks (PERHILITAN). Paya Indah Wetlands has served as a key pilot site for such activities, with programs targeted at educating school groups, tourists, and local communities (FRIM, 2022). However, there is limited empirical evaluation of the effectiveness of these CEPA efforts in enhancing public knowledge, attitudes, and conservation behaviours—an area that is increasingly highlighted in both national biodiversity strategies and global literature (IUCN, 2021; Mahmud et al., 2023).

2. MATERIALS AND METHODS

This study adopted both quantitative and qualitative approaches, with the primary focus on the quantitative method. A visitors' questionnaire survey was conducted during the visit to evaluate visitors' perceptions of Paya Indah Wetlands. A structured questionnaire was developed as the primary research instrument, specifically designed for face-to-face survey sessions with visitors at Paya Indah Wetlands (PIW). The questionnaire administered to daily visitors comprised five main sections. Section A focused on general awareness of biodiversity and wetland ecosystems. Section B assessed awareness of crocodiles, while Section C evaluated awareness of hippopotamuses. Section D measured perceptions of the effectiveness of biodiversity education programmes implemented within the wetland area; lastly, Section E collected respondents' socio-demographic information. Overall, the questionnaire was designed to capture comprehensive data on respondents' knowledge, attitudes, and awareness levels toward biodiversity conservation, while also evaluating the impact of biodiversity education initiatives as part of CEPA efforts at Paya Indah Wetlands (PIW).

2.1. Environmental education as a vehicle for change

Environmental education, especially in informal learning settings like nature parks and wetlands, has been shown to influence visitors' environmental awareness, values, and willingness to participate in conservation (Ardoin et al., 2020). The effectiveness of such education depends on the quality of interpretation, relevance of content, and emotional engagement (Ballantyne & Packer, 2005). Hence, biodiversity education embedded within CEPA activities is considered a powerful means to connect people to nature and foster conservation-minded behaviour. While CEPA initiatives have been actively implemented in PIW, there remains a lack of systematic evaluation of how well visitors understand wetland

and wildlife conservation after participation, and of the extent to which CEPA influences their attitudes and awareness.

The respondents were selected using stratified convenience sampling, stratified by local and international visitors based on the PIW/park's visitor arrival statistics. In this study, visitors' awareness of biodiversity and wetland environments was assessed using a Likert Scale. The factor on the habitat and wildlife loss in Malaysia was assessed using a series of six statements based on the general information in a quiz-type format with multiple-choice answers that were "true", "false", and "not sure". The effectiveness of the biodiversity programme in wetlands, awareness of crocodiles and river hippopotamus, and socio-demographic characteristics were assessed using a series of 12 statements based on the information available in PIW, in a quiz-type format with multiple-choice answers: "true", "false", and "not sure". The awareness and effective statements used in the survey were based on information found in the interpretation throughout PIW, namely general park information and scientific information, as well as the verbal briefing from the duty officers.

A total of 261 sets of questionnaires were collected, yielding a 99% response rate, and 100% (261 sets) were deemed usable for analysis. The survey data were analysed using descriptive statistics, simple linear regression, and the Pearson Chi-square test in the Statistical Package for the Social Sciences (SPSS). Observation was also carried out in this study, in which the researcher participated in interpretive programs at both the PIW Interpretation Center and two main substations of PIW, to determine the type of interpretation and the interpretive materials used in the programs.

A pilot study was conducted among 50 respondents to examine the test-retest reliability and internal consistency of the questionnaire. Cronbach's alpha is a reliability coefficient that measures the internal consistency of a set of survey items or other measurements. It indicates how well the items in a scale are related to each other, suggesting whether they measure the same underlying construct (Zitzmann & Orona, 2025). This study showed that a high Cronbach's alpha ($\alpha = 0.87$) indicates good internal consistency, meaning the items are likely measuring the same thing.

3. RESULT AND DISCUSSION

Based on the observations, daily visitors to Paya Indah Wetlands (PIW) engaged in self-directed exploration, with many also experiencing interpretive briefings conducted by on-duty staff or interpreters during designated wildlife feeding sessions. Feeding sessions were scheduled twice daily at both main substations: at 11:00 AM and 3:00 PM for the Crocodile Lake, and at 10:00 AM and 2:00 PM for the river hippopotamus enclosure. In addition to these scheduled sessions, several site activities operated without formal interpretive materials. Among the non-personal interpretive tools, introductory signage,

interpretive panels, and the Interpretation Center were the most frequently utilized by visitors. Both personal interpretation (e.g., guided walks and briefings) and non-personal interpretation were provided collaboratively by the Department of Wildlife and National Parks (PERHILITAN) and partner organisations, Gamuda Land. Notably, since October 2024, Gamuda Land has assumed responsibility for recreational services at PIW, including delivering visitor briefings and facilitating interpretive engagement.

3.1. Perceptions of the PIW environment and surroundings

The results showed that the reliability analysis for the six items measuring perceptions of the PIW environment yielded a high internal consistency (Cronbach's alpha, $\alpha = 0.923$). The statements involved in this perceptions were; 1) PIW functions as a center for environmental research and education, 2) educational activities, such as observing animals and wildlife at PIW, increase awareness of environmental conservation, 3) recreational activities such as wildlife observation or guided tours enhance experience and understanding of the importance of nature conservation, 4) I believe the presence of diverse wildlife at PIW reflects a healthy ecosystem that needs to be conserved, 5) Paya Indah Wetlands is an area rich in fauna diversity and 6) I feel safe visiting Paya Indah Wetlands even though there are crocodiles.

The measurement used was 5 for "Strongly agree" to 1 for "Strongly disagree". Respondents demonstrated a strong appreciation for the significance of PIW, particularly among urban dwellers. As presented in Table 1, respondents agreed that PIW is an important site for recreational activities such as wildlife observation and guided tours, which enhance visitors' experiences and understanding of nature conservation ($M = 4.59$). This was followed by positive responses regarding PIW's role in supporting environmental education and raising awareness about conservation, as well as its function as a representation of a healthy, and well-preserved ecosystem ($M = 4.54$). Respondents also recognized PIW as a center for environmental research and education ($M = 4.52$), due to the availability of various wildlife-related information. Additionally, respondents perceived the site as safe to visit despite the presence of certain wildlife species ($M = 4.49$), and acknowledged it as an area rich in faunal diversity ($M = 4.45$). These findings highlight the high societal value placed on PIW's conservation and educational functions, positioning it as a vital outdoor "classroom" for public engagement and awareness.

Respondents' perceptions of PIW were generally positive, with an average agreement scale exceeding 4.0 (Agree) for all statements presented. The total average mean was ($M = 4.52$) indicated the visitors generally hold positive perceptions of the Paya Indah Wetlands (PIW) environment and its surroundings. They recognize PIW as an important

center for environmental research and education, highlighting its role in promoting ecological awareness. Educational and recreational activities—such as observing wildlife and participating in guided tours—are seen as effective in enhancing visitors’ understanding of and appreciation for nature

conservation. This does support the general notion that wetland ecosystems can serve as sites for educational field trips and environmental-education purposes and justify describing PIW as an education outdoor centre (Rosita et al., 2025).

Table 1: Perceptions of the PIW environment (N=261).

Item	Mean (M=)	Std. Dev.	Percentage (%)				
			5	4	3	2	1
1. Paya Indah Wetlands functions as a center for environmental research and education.	4.52	0.726	63	30	7	0	1
2. Educational activities, such as observing animals and wildlife at PIW, increase awareness of environmental conservation.	4.54	0.682	61	34	4	0	1
3. Recreational activities such as wildlife observation or guided tours enhance experience and understanding of the importance of nature conservation.	4.59	0.677	66	30	3	0.4	1
4. I believe the presence of diverse wildlife at PIW reflects a healthy ecosystem that needs to be conserved.	4.53	0.726	62	33	3	0.4	2
5. Paya Indah Wetlands is an area rich in fauna diversity.	4.45	0.670	54	38	7	1	0
6. I feel safe visiting Paya Indah Wetlands even though there are crocodiles.	4.49	0.732	59	36	3	2	1
Average mean (M)			4.52				

5-Strongly agree (SA); 4-Agree (A); 3-Neutral (N); 2-Not agree/Disagree (D); 1-Strongly disagree (SD).

3.2. Perceptions of perceived quality of services and visitors' experience with staff

Table 2 presents respondents’ evaluations of their experience with PIW staff during their visit. Eight statements were used to evaluate the staff’s effectiveness in delivering biodiversity education at PIW. Findings from the study indicate that respondents’ overall experience with the staff ranged between ‘Satisfied’ and ‘Satisfactory’. All eight statements received an average score of 3.76, with the highest mean score of 3.83 recorded for the statement “Staff effectively raised awareness about biodiversity.”

This was followed closely by “Staff helped enhance understanding and knowledge about wildlife at PIW” and “Staff answered all visitor inquiries,” with mean scores of 3.82 and 3.81, respectively. The lowest score was 3.64, for the statement “Staff communicated in a clear and audible manner.” These findings serve as a useful benchmark for improving staff training and communication strategies at PIW, particularly to enhance the delivery of biodiversity education. The mean score was M = 3.79 for staff-assisted visitors' understanding of the importance of wildlife, which is close to 4.0 (Good or satisfied), indicating that the briefings and interpretive explanations at PIW were effective in enhancing visitors' understanding of wildlife's importance.

Table 2: Perceived quality of service and visitor experience with staff

Item	Mean (M=)	Std. Dev.	Percentage (%)				
			5	4	3	2	1
1. The staff's method of delivering information on wildlife at PIW	3.70	0.970	22	37	33	5	3
2. Staff assistance in helping visitors understand the importance of wildlife conservation	3.79	0.952	25	37	31	4	3
3. Staff effectiveness in raising awareness about biodiversity	3.83	0.952	31	31	31	5	3
4. Staff contribution in enhancing understanding and knowledge about wildlife at PIW	3.82	1.010	29	35	29	5	3
5. The methods used by staff were engaging and able to capture visitors' interest during the briefing	3.67	0.995	23	35	33	5	4
6. Staff were able to answer all visitor inquiries	3.81	1.015	26	38	30	3	3
7. Staff communicated in a clear and audible manne	3.64	1.020	21	36	32	7	4
8. The briefings from staff and interpretative explanations at PIW assisted visitors in understanding the importance of wildlife	3.79	0.919	20	48	25	3	3
Average Mean (M)			3.76				

Std. Dev = Standard Deviation. 5-Very satisfied; 4-Satisfied; 3-Moderately; 2-Dissatisfied; 1-Very satisfied

Notably, 68% of respondents rated the briefings and explanations as either 'Very satisfied' or 'satisfied'. The study underscores the critical role of environmental educators in shaping public awareness and understanding of conservation efforts, especially in biodiversity-rich areas such as Paya Indah Wetlands. The highest mean value (3.83) for the statement "Staff effectively raised awareness about biodiversity" suggests that PIW staff successfully fulfilled their interpretive and educational roles in communicating biodiversity-related messages. This aligns with findings by Wang (2015) in Taiwan who reported that the quality of interpretive services and staff interaction significantly influenced visitor satisfaction and perception of ecotourism experiences. In Wang's study, visitors who received clear explanations and guidance from park staff demonstrated higher levels of satisfaction, deeper understanding of ecological themes, and stronger pro-environmental attitudes compared to those who did not engage with staff-led interpretation.

This showed that visitors who engaged with PIW staff reported higher satisfaction and greater understanding of biodiversity themes — are consistent with empirical evidence showing that interpretive services and guide/educator interactions significantly shape visitor outcomes. Several studies demonstrate that guided interpretation and docent-led interactions improve visitor knowledge, strengthen emotional connection to place, and increase pro-environmental intentions and satisfaction.

Comparable trends have also been observed in the Southeast Asian context. For instance, Wan Mohamad Ariffin and Ching (2019) examined the effectiveness of environmental interpretation programmes in Kinabalu Park, Sabah, and found that guided interpretation significantly enhanced visitors' environmental knowledge and appreciation of biodiversity.

Their study emphasized that interpretive staff who communicate ecological values in simple, relatable ways contribute more effectively to visitors' understanding and overall satisfaction. This resonates with the PIW findings, where staff performance in communication and explanation were rated among the highest dimensions of visitor experience.

Taken together, these findings suggest that interpretive staff play an essential role in bridging scientific knowledge with public understanding of biodiversity. For Paya Indah Wetlands, the consistently positive visitor feedback demonstrates that staff-led interpretation has contributed meaningfully to visitor learning outcomes and satisfaction. However, to further enhance these outcomes, continuous professional development focusing on communication techniques, local ecological knowledge, and interpretive storytelling is recommended. As shown in both regional and international studies, sustained investment in staff capacity building can elevate biodiversity education from basic

awareness to deeper behavioral change and stewardship of nature.

3.3. The perceptions of PIW environment and Communication, Education, and Public Awareness (CEPA) activities in enhancing visitor awareness of wetland and wildlife conservation

3.3.1. Relationship between income level and perception of the PIW environment

An analysis was conducted to examine whether visitors' monthly income levels influenced their perceptions of the Paya Indah Wetlands (PIW) environment. The results revealed a statistically insignificant difference in environmental perception across income groups. A one-way ANOVA was conducted to determine whether respondents' monthly income levels influenced their perceptions of the Paya Indah Wetlands (PIW) environment. The analysis revealed no statistically significant difference among income groups, $F(1, 218) = 1.211$, $p = 0.200$. This indicates that monthly income was not a determining factor in respondents' valuation or perception of the environmental quality or importance of the PIW. This finding suggests that perceptions of environmental value in PIW may be broadly shared across income groups, likely influenced by other factors such as personal interest in nature, environmental awareness, or exposure to biodiversity education, rather than economic standing alone.

Table 3: Monthly income and the perceptions of the PIW environment

Source	Sum of Squares	Mean Square	<i>f</i>	Sig. (<i>p</i>)
Between Groups	18.700	0.492	1.211	0.200
Within Groups	88.559	0.406		
Total	107.259			

Note. Dependent variable: Perception of the PIW Environment. No statistically significant difference was found at the $p < .05$ level.

Socioeconomic variables (including income) were not significant; place attachment and conservation commitment were stronger predictors (Lee, 2011). Various studies have examined the relationship between socio-economic variables (such as income) and environmental perception, with mixed results. For example, Lo (2014) found a negative income effect on long-term environmental risk perception across 36 countries, indicating that individuals with higher incomes reported lower concern for environmental hazards. The visitor-based research in India (Chandran & Bhattacharya, 2021) revealed that income status did influence perceptions of environmental impact among ecotourists, highlighting that contextual factors matter significantly. Beyond income, other determinants—such as perceived environmental value and service/interpretation quality—have been found to exert a stronger influence on environmental awareness and satisfaction in forest and mangrove tourism settings (2024). Additionally, an investigation of ecological-environment satisfaction in China suggests that while higher-income

residents may derive higher material benefits, their expectations for environmental quality are elevated, complicating the income–perception relationship (Wu and Cao, 2023). In light of this literature, the finding in the present study that monthly income did not significantly influence visitors' perceptions of the PIW environment suggests that at PIW, visitor perceptions of environmental quality or value are shared broadly across income groups. The result indicates that variations in environmental perception are more likely influenced by factors such as personal environmental awareness, quality of visitor–staff engagement, interpretive learning experiences, place attachment, and previous exposure to nature, rather than by income level alone.

3.3.2. Relationships between the perception of the PIW environment and the perceived quality of service and visitor experience

On average, respondents reported highly positive perceptions of the PIW environment (M = 4.50, SD = 0.648), while satisfaction with staff service and experience was rated as moderately positive (M = 3.71, SD = 0.857). A Pearson

correlation analysis revealed a significant but weak positive association between environmental perceptions and staff satisfaction ($r = .158, p < .05$), indicating that visitors who perceived the environment more positively also tended to rate staff service more favourably. A simple linear regression analysis further examined this relationship and found that perceptions of the PIW environment significantly predicted satisfaction with staff service, $F(1, 260) = 6.50, p < .05$. The model explained approximately 2.5% of the variance in satisfaction levels ($R^2 = 0.025$). The regression coefficient was also significant ($\beta = 0.209, t = 2.549, p < .05$), suggesting that a one-unit increase in environmental perception was associated with a 0.209-unit increase in satisfaction with staff service. This finding aligns with previous evidence indicating that community engagement, institutional trust, and participatory awareness efforts are strong predictors of conservation support toward wildlife and sustainability (Mogomotsi et al., 2020). These results highlight that visitors' satisfaction and experience at PIW are shaped not only by service quality but also by their perceptions of the surrounding natural environment.

Table 4: The perception of the PIW environment and the perceived quality of service and visitor experience

Variable	Mean (M)	SD	r	R ²	F (df)	β	t	p-value
PIW Environment Perception	4.50	0.648	.158*	0.025	6.50 (1,	0.209	2.549	< .05
Satisfaction with Staff Service & Experience	3.71	0.857			260)			

Note: Pearson correlation is significant at the 0.05 level (2-tailed).

3.3.2. Socio-demographic profile

This study involved 261 respondents to assess the effectiveness of the biodiversity education programme in empowering Communication, Education and Public Awareness (CEPA) activities related to wildlife conservation at Paya Indah Wetlands (PIW). Based on the data collected, various socio-demographic characteristics of the respondents were recorded. For the employment status, most respondents were employed in the private sector or industry (34%), followed by public sector employees (29%), self-employed individuals (12%), homemakers (9%), retirees (7%), and the unemployed (2%). The sample also included university students (5%) and school students (3%). Regarding educational background, the majority of respondents held higher academic qualifications: 41% had a bachelor's degree, and 22% held a diploma or professional certificate. A smaller proportion held postgraduate qualifications at the master's or doctoral level (11%), while others had basic certification (5%), secondary education (17%), and only 2% had completed only primary school education. In terms of ethnic background, 91% of the respondents identified as Malay, followed by Indian (5%), Chinese (3%), and others (1%). Regarding gender, there was a slightly higher proportion of female respondents (53%) than male respondents (47%).

In terms of age, the largest group was 35-44 years old (39%), followed by 25-34 years old (33%). Respondents aged 15–24, 45–54, 55–64, and 65–74 years each represented less than 10% of the sample. Regarding residential background, the majority of respondents (79%) resided in urban areas, while the remainder (21%) came from rural areas. A significant number of respondents were from the state of Selangor (63%), followed by the Federal Territory (11%) and other states in smaller percentages. Regarding marital status, the majority of respondents (77%) were married, while the remaining 23% were single. Regarding gross monthly household income, most respondents reported earning between RM1,000 and RM3,000 (33%), RM3,001 and RM6,000 (33%), or RM6,001 and RM9,000 (14%), while a smaller proportion had higher monthly incomes ranging from RM9,001 to RM21,000 and above (20%).

Overall, the analysis of respondents' demographic profiles is significant for evaluating the effectiveness of the biodiversity education programme under the CEPA initiative at Paya Indah Wetlands. By understanding visitor backgrounds such as age, education level, employment type, and socioeconomic status, the programme's relevance and effectiveness in delivering conservation messages can be more accurately assessed. For example, individuals with higher levels of education and professional employment backgrounds

are more likely to understand the importance of biodiversity conservation and to support and practise conservation efforts in their daily lives. Conversely, for students or individuals from lower socioeconomic backgrounds, simpler, visual, and more interactive learning approaches may be more effective in enhancing understanding and awareness.

4. CONCLUSION

This study highlights the pivotal role of environmental education in enhancing public engagement and fostering long-term support for biodiversity conservation. Through the assessment of visitor experiences at Paya Indah Wetlands (PIW), the findings demonstrate that well-delivered communication by staff contributes meaningfully to improving awareness, understanding, and appreciation of wildlife and wetland ecosystems. The generally positive feedback—reflected in average scores above 3.5 for all evaluation items—indicates the effectiveness of staff in delivering biodiversity education, particularly through the CEPA (Communication, Education, and Public Awareness) approach. Notably, visitors acknowledged the staff's ability to raise awareness, respond to inquiries, and deepen understanding of conservation issues. This study highlights the critical role of environmental education in enhancing public understanding and engagement in biodiversity conservation. By evaluating visitor experiences and perceptions at Paya Indah Wetlands (PIW), the findings demonstrate that the CEPA (Communication, Education, and Public Awareness) activities implemented have been effective in increasing awareness and knowledge of wetland and wildlife conservation.

Respondents reported a high level of environmental perception and moderately positive experiences with staff, indicating that educational efforts and service quality at PIW are aligned with conservation goals. Statistical analyses revealed a significant, though modest, positive relationship between perceptions of the PIW environment and satisfaction with staff service, further underscoring the interlinkage between environmental experience and visitor engagement. The insights gained from this research provide valuable feedback for improving the delivery of biodiversity education and enhancing visitor-staff interactions. These findings also serve as a benchmark for strengthening CEPA strategies at other ecotourism and conservation sites across Malaysia. Ultimately, fostering positive environmental perceptions and quality visitor engagement is essential for sustaining long-term conservation outcomes.

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REFERENCES

- Ardoin, N. M., Bowers, A. W., & Gaillard, E. (2020). Environmental education outcomes for conservation: A systematic review. *Biological Conservation*, 241, 108224. <https://doi.org/10.1016/j.biocon.2019.108224>
- Ballantyne, R., & Packer, J. (2005). Promoting environmentally sustainable attitudes and behaviour through free-choice learning experiences: What is the state of the game? *Environmental Education Research*, 11(3), 281–295. <https://doi.org/10.1080/13504620500081145>
- Chandran, C., & Bhattacharya, P. (2021). Perception of Visitors on Ecotourism Environmental Impact: A Study of Munnar, Kerala, India. *World Journal of Environmental Biosciences*, 10(2), 1-8.
- Gough, A. (2002). Mutualism: A different agenda for environmental education research. *Australian Journal of Environmental Education*, 18(1), 31–45. <https://doi.org/10.1017/S081406260001012>
- IUCN (International Union for Conservation of Nature). (2021). *Communicating biodiversity: A strategic approach to engaging people*. Gland, Switzerland: IUCN.
- Lee, T. H. (2011). How recreation involvement, place attachment, and conservation commitment affect environmentally responsible behavior. *Journal of Sustainable Tourism*, 19(7), 895–915. <https://doi.org/10.1080/09669582.2011.570345>
- Lo, A. Y. (2014). Negative income effect on perception of long-term environmental risk. *Ecological Economics*, 107, 51–58. <https://doi.org/10.1016/j.ecolecon.2014.08.009>
- Mogomotsi PK, Mogomotsi GEJ, Dipogiso K, Phonchi-Tshekiso ND, Stone LS, Badimo D. An Analysis of Communities' Attitudes Toward Wildlife and Implications for Wildlife Sustainability. *Tropical Conservation Science*. 2020;13. doi:10.1177/1940082920915603.
- Sterling, S., Dawson, J., & Warwick, P. (2017). Enhancing sustainability education in higher education through the value of critical reflective practice. *Journal of Transformative Education*, 15(3), 250–270. <https://doi.org/10.1177/1541344616685046>
- Ramsar Convention Secretariat. (2008). *Communication, Education, Participation and Awareness (CEPA) Programme 2009–2015*. Gland, Switzerland: Ramsar Convention.
- Ramsar Convention Secretariat. (2016). *An introduction to the Convention on Wetlands (Ramsar, Iran, 1971)*. Gland, Switzerland: Ramsar Convention Secretariat.
- Rosita, L., Sumarmi, Astina, I. K., Utaya, S., & Bachri, S. (2025). Enhancing enjoyable learning in geography education through field trips to wetland ecosystems: A mixed-method study. *Educational Process: International Journal*, 14. <https://doi.org/10.22521/edupij.2025.14.73>
- Wan Mohamad Ariffin, W.N.S. & Ching, G.H. (2019). The effectiveness of environmental interpretation in influencing visitors' knowledge in Kinabalu Park. *Asian Journal of Environment-Behaviour Studies*, 4 (14), 67–80.
- Wang, W. C. (2015). Visitor perception, interpretation needs, and satisfaction of eco-tourism: The case of Taijiang National Park, Taiwan. *Enlightening Tourism: A Pathmaking Journal*, 5 (2), 180-200.

- Wu, Y., & Cao, Y. (2023). Research on the Influence of Ecological Environment Satisfaction and Income Level on Chinese Residents' Happiness: Empirical Analysis Based on CGSS Data. *Sustainability*, 15(10),8175. <https://doi.org/10.3390/su15108175>
- UNESCO (2019). *Learning for nature: Environmental education for biodiversity conservation*. Paris, France: UNESCO Publishing.
- Zitzmann, S., & Orona, G. A. (2025). Why we might still be concerned about low Cronbach's alphas in domain-specific knowledge tests. *Educational Psychology Review*, 37(2), Article 37. <https://doi.org/10.1007/s10648-025-10015-5>.